FIRE HISTORY OF AN OLD-GROWTH FOREST OF *SEQUOIA SEMPERVIRENS* (TAXODIACEAE) FOREST IN HUMBOLDT REDWOODS STATE PARK, CALIFORNIA

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ABSTRACT

Establishment dates of basal sprouts of *Sequoia sempervirens* were found to be reliable estimates of known fires in Redwood National Park and Prairie Creek State Park in Humboldt Co., California. Fire history of an old-growth *S. sempervirens* forest in the Bull Creek watershed in Humboldt Redwoods State Park, northwestern California, was determined by analyzing *S. sempervirens* basal sprouts, fire scars, and dates of establishment of *Pseudotsuga menziesii* and *Abies grandis.* Fire frequency was estimated for watershed zones, for a clearcut area having fire scars, and for the entire study area. Conservative and liberal estimates of the fire cycle were made. Presettlement fire intervals were: 24.6 yr for watershed zones, 31 yr for the area with fire scars, and 13.3 yr for the entire study area. The conservative estimate of the fire cycle was 51.6 yr and the liberal estimate was 26.2 yr. Settlement fire intervals were: 15.6 yr for watershed zones and 7.5 yr for the entire study area. The conservative and liberal estimates of the fire cycle were 16 and 10 yr. Post-settlement fire intervals were: 7.8 yr for the watershed zones, 14 yr for the area with fire scars, and 4.5 yr for the entire study area. The conservative and liberal estimates of the fire cycle were 16 yr and 9.5 yr. Statistically significant differences ($p < 0.05$) were found between the fire interval means for all three settlement periods. No statistically significant differences ($p > 0.05$) were found between settlement period and fire size. Fire size was not correlated with fire frequency.

Throughout the 800 km range of *Sequoia sempervirens* there is abundant evidence of fire. In nearly all groves, trees exhibit fire scars, hollowed-out bases (goose pens), and/or bark char that extend many meters up the bole. The role of fire in *S. sempervirens* has been discussed (Fisher 1903, Fritz 1931, Stone 1966, Veirs 1982). One approach to deduce fire's natural role has been to determine fire history by aging fire scars on stumps. Near the southern end of the range of *S. sempervirens,* mean fire intervals of approximately 50 years (Greenlee 1983), and 22–27 yr (Jacobs et al. 1985) have been reported. Fire intervals near the northern end of the range have been reported to vary from 50–500 yr, that increase along a continuously mesic east to west gradient (Veirs 1982). Fritz (1931) concluded that on a 12 ha area, to the east of Weott, California, there was an average of 4 major fires per century over the past 1100 yr.

These studies provided good estimates of historic fire frequency, but did not establish exact calendar dates for fires and did not in-

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dicate what size the fires may have attained. The determination of exact calendar dates is difficult because of 1) weathering of the outer rind of sapwood on old *S. sempervirens* stumps that obliterates the most recent annual rings, 2) the difficulty in determining when trees were cut, and 3) the production of discontinuous rings or absence of rings at stump height for large trees during drought or stress periods (Fritz 1931, LaMarche and Wallace 1972). An alternate method of determining fire frequency is to date *S. sempervirens* basal sprouts that presumably developed following fire. By using basal sprouts, the first two problems are eliminated and the latter problem would be minimized because the sprouts would be younger, more vigorous trees. Therefore, they would be less likely to have discontinuous or missing rings (LaMarche and Wallace 1972). Missing rings, however, are possible on young, vigorous sprouts if adjacent sprouts have grown together. Fritz (in Douglass 1928) observed that the interior radii of joined stump sprouts had fewer annual rings than did the exterior radii or those radii above the junction of the sprouts. This phenomenon can be avoided by sampling solitary sprouts. Lack of certainty that a sprout developed following fire is another possible problem in using basal sprouts as an indicator of historic fires. Although it has been well established that *S. sempervirens* sprouts following fire (Fritz 1931, Wiant and Powers 1967, Daubenmire 1975, and many others), it also sprouts following mechanical injury to its base (Fisher 1903, Wiant and Powers 1967, Lindquist 1979, and many others). When there is a ring of basal sprouts around a fire-damaged old-growth parent tree, it can be assumed that the sprouts developed because of fire.

The present study was undertaken to 1) verify that basal sprouts can be used to determine fire frequency; 2) determine the historic fire frequency in an old-growth *S. sempervirens* forest by dating basal sprouts and fire scars on stumps of *S. sempervirens,* and by dating other conifer species (*Pseudotsuga menziesii* and *Abies grandis*), and 3) estimate the area burned by each fire so that a fire cycle can be calculated.

Fire Records

Pre-1940 agency fire records are poor (Wallis et al. 1963). Archival fire records of the California Department of Forestry are incomplete for the 1920's and 1930's and for some years no records exist. There are no pre-1920 fire records on file. Gripp (1976) reviewed extensively the northwestern California newspapers and various other documents and found that large fires in Humboldt and Del Norte cos. were common. He concluded that between 1880–1939 the mean interval between severe fire seasons was 3.3 ± 0.79 (s.e.) yr.

In a study of large fires occurring in Humboldt and Del Norte cos.

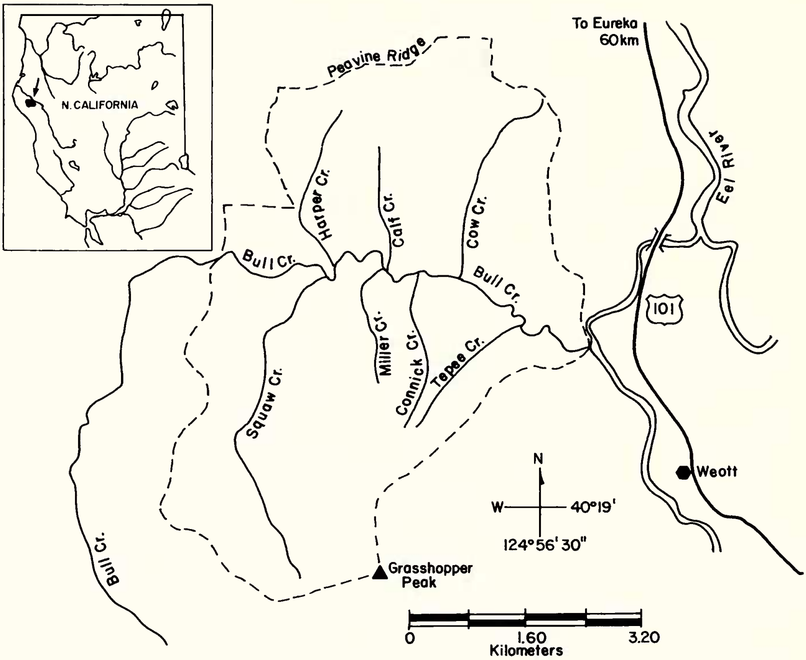

FIG. 1. Location of the study area in the Bull Creek watershed, Humboldt Redwoods State Park, northwestern California.

between 1955–1974, Gripp (1976) found that 89% were associated with three major synoptic weather systems: the Pacific High (post-frontal), the Great Basin High, and the Subtropical High Aloft pattern. These weather patterns can be expected to occur 50–55 days per summer fire season (Hull et al. in Gripp 1976). The greatest number of days of critical fire weather can be expected to occur in July, August, and September. Sixty-nine percent of the large fires (1955–1974) in Humboldt and Del Norte cos. occurred during August and September (Gripp 1976).

STUDY SITE

This study was conducted in a ca. 3500 ha old-growth *S. sempervirens* and *Pseudotsuga menziesii* forest growing in the Bull Creek watershed of Humboldt Redwoods State Park, California (Fig. 1). The forest includes the Rockefeller Forest that occurs 35 km east of the coast and experiences none of the moderating influence of the Pacific Ocean on summer temperature and humidity to the same extent as do the coastal *S. sempervirens* groves to the north. Inland sites typically have summer temperatures between 20–30°C and relative humidities between 40–50%, whereas coastal sites experience summer temperatures of 15–18°C and relative humidities between 80–90% (Horn 1966, Azevedo and Morgan 1974, Elford and McDonough 1974). Summer fog flowing up the Eel River Valley often drifts into the Bull Creek watershed. Fog, however, occurs less frequently in the Rockefeller Forest than it does in *S. sempervirens* groves along the Eel River or closer to the ocean (Waring and Major 1964, Azevedo and Morgan 1974). As a result, the Bull Creek drainage experiences greater diurnal and annual temperature extremes. Summer droughts are common with nearly all of the 760–2500 mm of precipitation falling as rain from October to April.

The watershed's topography is varied with slopes from 0% to more than 50%. Elevations range from 50 m at the mouth of Bull Creek to roughly 1030 m. Potential fire hazard is higher in the Bull Creek watershed than in coastal *S. sempervirens* because of the steep slopes and relatively severe summer fire weather.

Nearly pure stands of *S. sempervirens* are found along the alluvial flats of Bull Creek. Occasional overstory associates include *Abies grandis* and *P. menziesii.* Understory associates include *Lithocarpus densiflorus, Umbellularia californica, Vaccinium ovatum, Gaultheria shallon, Polystichum munitum,* and *Oxalis oregana.*

On the slopes above the alluvial flats, the density and basal area of *S. sempervirens* declines with increasing elevation, although this species dominates (greatest basal area) nearly everywhere it is found. At lower elevations, *S. sempervirens* is associated with *P. menziesii, A. grandis, L. densiflorus, A. menziesii,* and *U. californica.* On rocky sites or near prairies, *Quercus garryana* and *Q. kelloggii* are found. At higher elevations, *A. grandis, U. californica, Q. garryana,* and *Q. kelloggii* are absent or rare, whereas *L. densiflorus* and *A. menziesii* increase in density and basal area. *Lithocarpus densiflorus* saplings and *V. ovatum* thickets are found in the understory at all slope elevations.

Land Use History

Pre-settlement period (pre-1875). Pre-settlement fires in the Bull Creek watershed probably were caused mostly by Indians. Lightning activity in this part of the range of *S. sempervirens* is relatively low, but it is often accompanied by rainfall when it does occur (Fritz 1931). The Sinkyone Indians were the primary inhabitants of this region. They migrated through the watershed on their way from the South Fork of the Eel River to the Pacific Ocean and had established villages in and near the watershed. Regular burning by the Sinkyones has been reported as a means to drive out insects and rodents for food and to keep the forest understory open for travel (Fritz 1931, Gilligan 1966).

Settlement period (1875–1897). European man arrived in the vicinity of Bull Creek in 1848 when four members of Dr. Josiah Gregg's expedition from Weaverville to San Francisco proceeded up the South Fork of the Eel River. It was not until the early 1870's, however, that settlement occurred. One of the earliest settlers was Tosaldo Johnson who grazed sheep and cattle on prairies in what is now known as the Rockefeller Forest. By 1895, most of the Bull Creek watershed had been claimed under provisions of the Homestead Act. Fire was used by early settlers for the maintenance and enlargement of pastures and for land clearing (Gilligan 1966). Many fires escaped into the forests because of the lack of organized fire suppression.

Post-settlement period (1898–1940). The major land use activities from 1895–1945 were livestock grazing, farming, debarking of *L. densiflorus* for tannin production, and logging of *P. menziesii* and *S. sempervirens.* Broadcast burning was used regularly during this period to maintain pastureland (Gilligan 1966), and to facilitate logging activities. Logged areas were burned commonly prior to log skidding to reduce the impediments of logging debris and understory vegetation (Fritz 1931). Many of these fires burned into old-growth *S. sempervirens* stands, but apparently were extinguished naturally because of a combination of lower temperatures, higher relative humidities, and high fuel moisture contents. In years when the fuels were especially dry and the weather hot or windy, however, fire readily spread through the *S. sempervirens* forest. For example, in 1936 a fire spread southward from a broadcast burn on property of the Pacific Lumber Company into an old-growth *S. sempervirens* forest in the Bull Creek watershed (unpubl. fire report, Calif. Dept. of Forestry 1936). In 1936, there were many other fires burning in old-growth *S. sempervirens* forests on the north coast of California. Although fire archives of the California Department of Forestry probably do not contain all of the fire reports for 1936, the existing reports indicate that there were fires that covered from 86–4856 ha in areas of old-growth *S. sempervirens* in Humboldt and Del Norte cos. All of these fires originated from escaped broadcast burns or other incendiary activities.

After 1945, land use patterns changed with the implementation of the State Forest Practices Act and with more vigorous fire suppression. As a result, the number of escaped fires from agricultural or logging activities has been reduced greatly.

Methods

The test to verify that basal sprouts can be used to determine fire frequency was conducted in northern Humboldt Co., 130 km north of the main study area. All other data were collected in the Bull Creek watershed, Humboldt Redwoods State Park.

Basal sprout ages and fire frequency. Establishment dates of basal sprouts were determined in three areas of old-growth *S. sempervirens* that are known to have experienced fires. One of the areas burned in October 1974 along a tributary of Redwood Creek in Redwood National Park (RNP), and the other two areas burned during a fire of late September 1936 near the northern boundary of Prairie Creek State Park. The exact location of the 1974 fire was determined from records on file at RNP and by eyewitness accounts (Veirs, pers. comm. 1983). Locations of the two areas in the 1936 fire were determined using a fire report (unpubl. fire report, Calif. Dept. of Forestry 1936), and re-establishing photo points used in the taking of photographs following the fire (photos on file at RNP). A total of 20 basal sprouts from different parent trees were dated from the three areas: 10 from the 1974 fire, and five from each of the two 1936 fire areas. Basal sprouts were sampled next to trees that had bark char or fire scarring, and those sprouts that had no external evidence of fire. Increment corings were extracted at a height of 15 cm, cross sections were removed approximately 10 cm above ground level, and both were sanded and examined under a microscope. A correction factor of one year was added to the dates determined by counting annual rings.

Fire history study. Fifty-nine sample points were established in a 0.80 km^2 grid pattern in the 3500 ha old-growth *S. sempervirens* and *P. menziesii* forest that occurs in the eastern portion of the Bull Creek watershed. All trees of *S. sempervirens* within a 150 m radius of the sample point were examined for basal sprouts and evidence of past fires. Any sprout whose parent had a fire scar or bark char was assumed to have resulted from a fire. There were often two and three generations of basal sprouts evident from one parent tree (Fig. 2). The number of sprouts age $class^{-1}$ parent $tree^{-1}$ was variable, but usually was only one or two. Increment cores were extracted from basal sprouts of all apparent age classes as close to the base of their stems as possible, although usually within 25 cm of ground level. The cores were mounted in permanent holders, sanded, and examined under a microscope.

Dates of sprout establishment were determined by summing the number of years counted on the extracted increment cores to the mean annual height growth of basal sprouts. Mean basal sprout height growth for the first year following three prescribed burns near Look Prairie was 37 $\pm$ 11.7 (s.e.) cm (Stuart 1986). Crossdating was attempted, but was found to be ineffective primarily because of strong competitive interactions and variable radial growth patterns.

FIG. 2. Two generations of *Sequoia sempervirens* basal sprouts. Parent tree has a fire scar at its base, and charred bark extending approximately 10 m up its stem.

Studies in *S. sempervirens* by Douglass (in Schulman 1940), Schulman (1940), and LaMarche and Wallace (1972) have found similar difficulties in crossdating *S. sempervirens* cross sections. Fire dates were recognized if there was synchrony among basal sprout dates. To help substantiate the basal sprout fire dates, increment corings were extracted from adjacent *P. menziesii* and *A. grandis.* It was assumed that these species became established following the liberation of growing space by a fire. A similar pattern was observed by Veirs (1982) in *S. sempervirens* stands that occur 150 km to the north of the study site, where *P. menziesii* and *Tsuga heterophylla* became established after ground fires.

Additional fire dates were obtained by dating fire scars on stumps found in an old clearcut. All but one of the several clearcuts that were scattered throughout the forest were cut too long ago and yielded rotten, unusable stumps. A 35-year-old clearcut unit on a northwest aspect, however, was found whose stumps were sound enough to be used. Following a reconnaissance, five stumps were found showing two or more fire scars. Crossdating was performed for those stumps with uninterpretable sapwood rings using fire intervals established with *S. sempervirens* basal sprouts.

The original objective of determining exact historic fire boundaries could not be achieved because equal-aged basal sprouts from individual trees were dispersed too widely. Some reasons for this were: 1) the density of *S. sempervirens* on slopes was relatively low (10–40/ha); 2) not every *S. sempervirens* sprouted following fire, leading to highly dispersed equal-aged basal sprouts; and 3) some basal sprouts were killed by subsequent fires, which led to even greater dispersion of equal-aged basal sprouts. In spite of these factors, two estimates of fire size were attempted based on aspect and position within the Bull Creek watershed. Eleven zones were delimited (Table 1) to represent areas of similar aspect and watershed position. The first estimate of fire size was a liberal one based on the assumption that an entire watershed zone burned if there was any evidence of fire in that zone. Fire size was then estimated by summing the areas of those fire affected zones. Although this technique overestimates fire size for small local fires, it is probably realistic for many presettlement and unsuppressed fires. Those fires likely burned for weeks at a time, especially during drought periods, and were extensive. Many of the large 1936 fires, for example, in *S. sempervirens* forests on the north coast of California, burned for 2–3 weeks even with fire suppression (unpubl. fire reports, Calif. Dept. of Forestry 1936). The second estimate of fire size was more conservative. I assumed that, for a watershed zone to burn completely, it must have had more than one plot with evidence of fire. For those watershed zones having only one plot with evidence of fire, I assumed that the fire

TABLE 1. ZONES REPRESENTING AREAS OF SIMILAR ASPECT AND WATERSHED POSITION WITHIN THE OLD-GROWTH PORTION OF THE BULL CREEK DRAINAGE. Mean pre-settlement fire intervals for each zone are presented (data are $\bar{x} \pm$ s.e.).

Fire zones	Area (ha)	Aspect	Mean fire interval
Harper Creek	368	S	21.8 (6.7)
Calf Creek	337	S	31.0 (12.1)
Western Cow Creek	397	SE	23.4 (11.6)
Eastern Cow Creek	433	SW, W	34.8 (8.4)
Tepee Creek	286	NE	19.5 (4.9)
Connick Creek	190	N	43.7 (14.2)
Miller Creek	223	N	36.3 (25.3)
Lower Eastern Squaw Creek	261	NW	11.3 (6.7)
Upper Eastern Squaw Creek	410	NW, W	21.0 (5.1)
Lower Western Squaw Creek	257	NE, N	18.2 (3.3)
Upper Western Squaw Creek	348	NE, E	21.8 (9.2)
	3510		24.6 (2.8)

burned $\frac{1}{59}$ of the entire study area, i.e., 3500 ha/59 plots = 59.3 ha. Once fire size was estimated, I calculated conservative and liberal estimates of the fire cycle for the post-settlement (1898–1940), settlement (1875–1897), and pre-settlement periods (pre-1875). The fire cycle is defined as the length of time necessary for an area equal to the entire area of interest to burn (Romme 1980).

RESULTS

Basal sprout ages and fire frequency. Dates of basal sprout establishment in the three sampling areas verified the known fire dates. In the area of the late season 1974 fire, nine out of 10 basal sprouts were determined to have been established in 1975, with the other basal sprout dated at 1976. Similar results were found in the two sampling areas in the area of the late season 1936 fire. Eight out of 10 basal sprouts were dated to 1937; one was dated to 1938; and one was found to have been established in 1940.

Fire history study. Fire frequencies for the pre-settlement, settlement, and post-settlement periods were calculated for individual watershed zones, the entire study area, and for the 35-year-old clear-cut (fire scars only). The pre-settlement mean fire interval for the 11 watershed zones ranged from 11.3 ± 6.7 (s.e.) yr to 43.7 ± 14.2 (s.e.) yr (Table 1). There were no statistically significant differences ($p > 0.05$) between the pre-settlement mean fire intervals of the watershed zones. The average of the mean pre-settlement fire intervals of the 11 watershed zones was 24.6 ± 2.8 (s.e.) yr. Shorter mean fire intervals were found for the settlement [15.6 ± 1.5 (s.e.) yr] and the post-settlement [7.8 ± 0.6 (s.e.) yr] periods. No statistically significant differences ($p > 0.05$) were found between the mean fire

TABLE 2. FIRE DATES AND FIRE INTERVALS DETERMINED FROM *Sequoia sempervirens* BASAL SPROUTS, CONIFER (*Pseudotsuga menziesii* AND *Abies grandis*) ESTABLISHMENT DATES, AND FIRE SCARS IN THE OLD-GROWTH PORTION OF THE BULL CREEK DRAINAGE.

	Fire year	No. of fire scars	No. of basal sprouts	No. of conifers est.	Fire interval (yr)
Post-settlement period	1940	2	3	1	4
	1936	—	11	2	6
	1930	—	8	—	3
	1927	—	4	1	4
	1923	1	5	—	4
	1919	—	13	6	6
	1913	1	3	1	4
	1909	—	6	4	5
	1904	—	8	5	6
	1898	2	6	1	3
Settlement period	1895	—	4	2	7
	1888	—	15	4	5
	1883	—	6	3	8
	1875	—	4	5	10
Pre-settlement period	1865	1	6	4	8
	1857	—	7	5	11
	1846	—	5	6	11
	1835	4	5	4	9
	1826	—	3	3	9
	1817	—	4	1	15
	1802	1	7	5	18
	1784	—	5	—	20
	1764	2	—	—	16
	1748	—	5	1	9
	1741	2	2	—	15
	1726	—	6	—	19
Incomplete data	1707	2	—	—	12
	1695	—	2	—	9
	1686	—	2	—	38
	1648	—	2	—	37
	1611	—	2	—	13
	1598	1	1	—	12
	1586	—	1	—	17
	1569	1	—	—	63
	1506	—	1	—	11
	1495	—	1	—	26
	1469	—	1	—	139
	1330	1	—	—	—

intervals of the eleven watershed zones for either the settlement or post-settlement periods.

Considerable variability was found in fire intervals within watershed zones and between the fire intervals of all watershed zones.

Pre-settlement fire intervals varied from 8–87 yr. The coefficients of variation for pre-settlement fire intervals for individual watershed zones ranged from 36–120% and for the means of fire intervals of all watershed zones it was 37.8%.

Fire intervals calculated for the entire study area in each fire year and averaged for the three time periods are shown in Table 2. The post-settlement period had the lowest mean fire return interval [4.5 ± 0.6 (s.e.) yr], with the settlement period, and pre-settlement periods having longer intervals [7.5 ± 0.8 (s.e.) yr, and 13.3 ± 1.2 (s.e.) yr, respectively]. Statistically significant differences ($p < 0.05$) were found between the fire interval means for all three time periods.

The fire intervals calculated from the fire scar data exhibited a similar trend as the other two estimates, with a longer fire interval [31 ± 3.1 (s.e.) yr] in the pre-settlement period and a shorter fire interval [14 ± 2.0 (s.e.) yr] for the post-settlement period. There were no fire scars found for the settlement period.

No statistically significant differences ($p > 0.05$) between time periods and either the conservative or liberal estimates of fire size were found. Mean fire size based on the conservative estimate for the post-settlement period was 918 ± 162 (s.e.) ha, for the settlement period 1097 ± 362 (s.e.) ha, and for the pre-settlement period 786 ± 139 (s.e.) ha. The mean fire size based on the liberal estimate for the post-settlement period was 1748 ± 121 (s.e.) ha, for the settlement period 2018 ± 151 (s.e.) ha, and for the pre-settlement period 1629 ± 167 (s.e.) ha. Fire frequency was not correlated with either the conservative or the liberal estimates of fire size ($r = -0.215$, $p = 0.100$; $r = -0.254$, $p = 0.100$, respectively). Fire cycles calculated using the conservative estimate of fire size were 51.6, 16.0, 16.0 yr for the pre-settlement, settlement, and post-settlement periods. The fire cycles using the liberal fire size estimates were 26.2, 10.0, and 9.5 yr for the same periods. A comparison of the five estimates of fire frequency are presented in Table 3.

Discussion

Fire frequency based on watershed zones, the entire study area, fire scars, and two estimates based on the fire cycle were all similar. Each of these methods revealed a pattern of relatively long fire intervals during the pre-settlement period, shorter fire intervals during the settlement period, and still shorter fire intervals during the post-settlement period. The mean pre-settlement fire intervals for all the watershed zones (24.6 yr), and for the area with fire scars (31 yr) were similar to those reported by Fritz (1931; ca. 25 yr) and Jacobs et al. (1985; 22–27 yr). The shorter pre-settlement fire interval based on the entire study area (13.3 yr) was an artifact of the size of the reference area. A large sampling area is likely to include more

TABLE 3. ESTIMATES OF FIRE FREQUENCY FOR THE OLD-GROWTH PORTION OF THE BULL CREEK WATERSHED. Frequency estimates are presented for the post-settlement, settlement, and pre-settlement periods. Fire interval data are $\bar{x} \pm$ s.e.

	Post-settlement	Settlement	Pre-settlement
Fire interval (yr)			
Based on entire study area	4.5 (0.6)	7.5 (0.8)	13.3 (1.2)
Based on scars from 1 site	14.0 (2.0)	—	31.0 (3.1)
Based on watershed zones	7.8 (0.6)	15.6 (1.5)	24.6 (2.8)
Fire cycle (yr)			
Conservative estimate	16.0	16.0	51.6
Liberal estimate	9.5	10.0	26.2

evidence of past fires than a smaller one (Arno and Petersen 1983). My entire study area, for example, was 3500 ha, whereas the largest watershed zone was only 433 ha. The studies by Fritz, Veirs (1982), and Jacobs et al. were conducted in areas less than 100 ha.

Fire frequency estimates based on the fire cycle should be considered only as estimates because I was unable to reconstruct exact fire perimeters. The liberal estimate of the fire cycle (26.2 yr) should be considered the probable minimum time; and the conservative estimate (51.6 yr) should be considered as the probable maximum time. It is unlikely that the true fire cycle, especially for the pre-settlement period, is greater than my conservative estimate because pre-settlement fires were not suppressed and, therefore, were probably more extensive.

Pre-settlement fire frequencies were highly variable and no significant differences were found between pre-settlement mean fire intervals among the eleven watershed zones. These phenomena are probably due to large variances within and between watershed zones and the small number of intervals in each watershed zone. Ecological and land management inferences based solely on pre-settlement mean fire intervals would be simplistic. Any prescribed burning program designed to recreate pre-European man fire regimes should incorporate variable intervals between fires (McBride et al. 1986) within and between watershed zones.

The longer fire intervals (50–500 yr) reported by Veirs (1982) can be attributed to the relatively mild fire weather conditions found in coastal *S. sempervirens* forests (Elford and McDonough 1974, Gripp 1976). Differences in fire frequency throughout the range of *S. sempervirens* are apparently a function of the steep climatic gradient extending from the cool, moist coastal sites to the relatively warm, dry inland sites.

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ANNOUNCEMENT

VASCULAR PLANTS OF ARIZONA

Taxonomists interested in the flora of Arizona have convened several times since summer 1986 to organize a working group to produce a new plant identification manual for the state. Because *Arizona Flora* by Kearney and Peebles is out-of-print, a seminar intended for potential users was hosted by the Herbarium of the University of Arizona at Tucson, addressing the subject, "Revising *Arizona Flora*: What do you want?" in discussion format.

As a result of the seminar an editorial board, consisting of Frank S. Crosswhite, editor-in-chief, Richard S. Felger, Charles T. Mason, Jr., Donald J. Pinkava, John R. Reeder, and Rebecca K. Van Devender, has been established. It will govern all stages of production from planning to actual printing and publication. Several decisions have been made. The new book will be entitled *Vascular Plants of Arizona* and will be consistent in size, shape and complexity with *Gray's Manual of Botany,* although not necessarily consistent in style and format. The editors wish the book to include the works of the most highly qualified experts for each taxonomic group and solicit communication with all interested in contributing. Treatments accepted and published will be acknowledged with an authorship by-line. Guidelines for authors are being prepared and will be available from Rebecca K. Van Devender, Herbarium, College of Agriculture, University of Arizona, Tucson 85721.